Introduction to Anaerobic Digesters for the Swine Industry

USEPA AgSTAR Program
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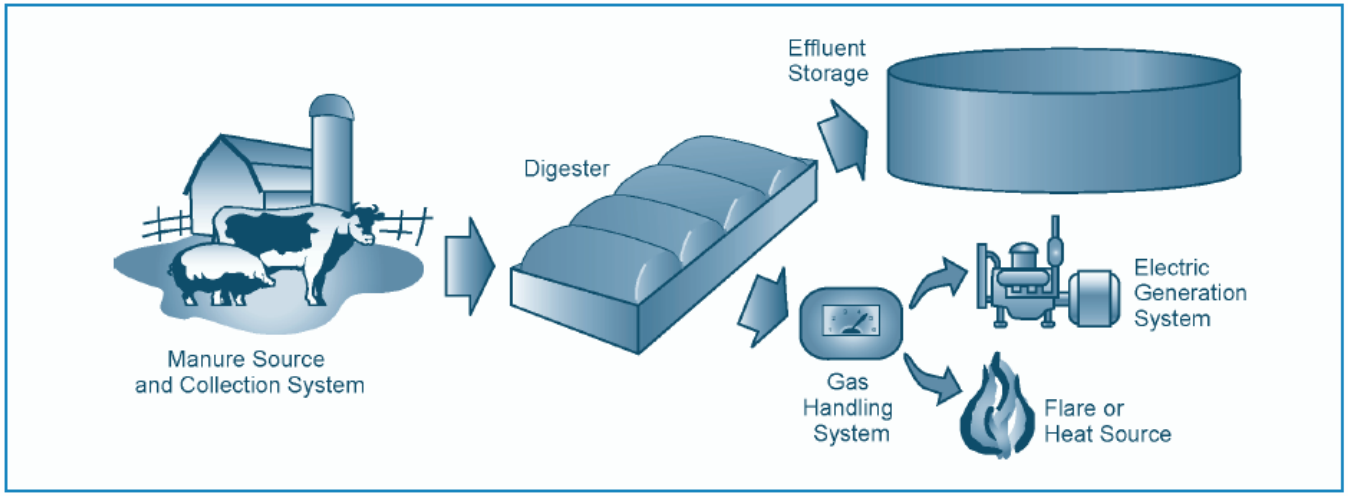
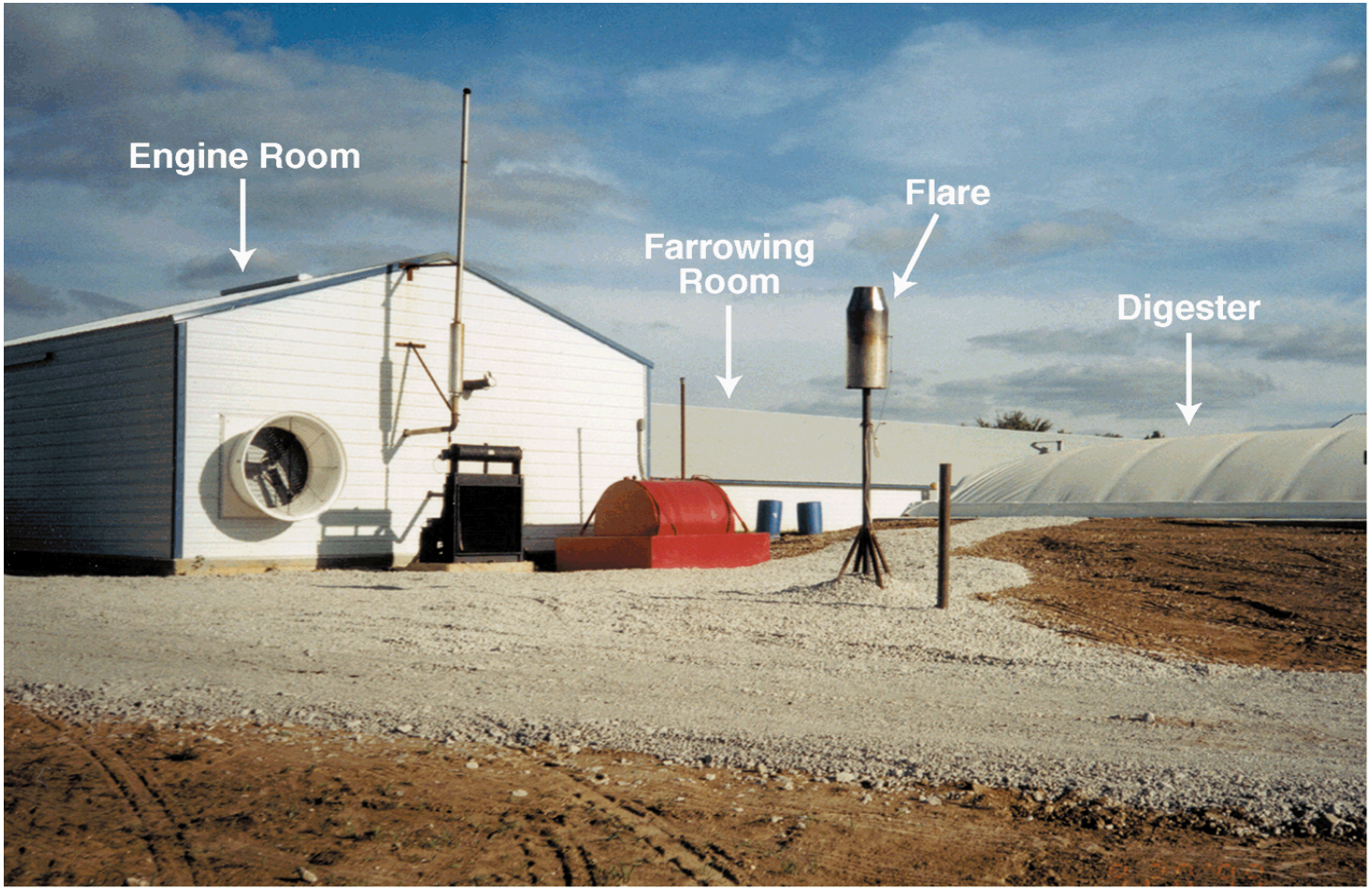
What are Anaerobic Digesters?

- Biological treatment/stabilization systems applicable to liquid, slurry, and semi-solid waste, which collect and combust off-gases.
- Digesters separate manure treatment from storage functions, which can result in lower initial installation costs for new or expanding farms.
- Anaerobic digestion is a biological process that consumes organic matter in an oxygen-free environment.



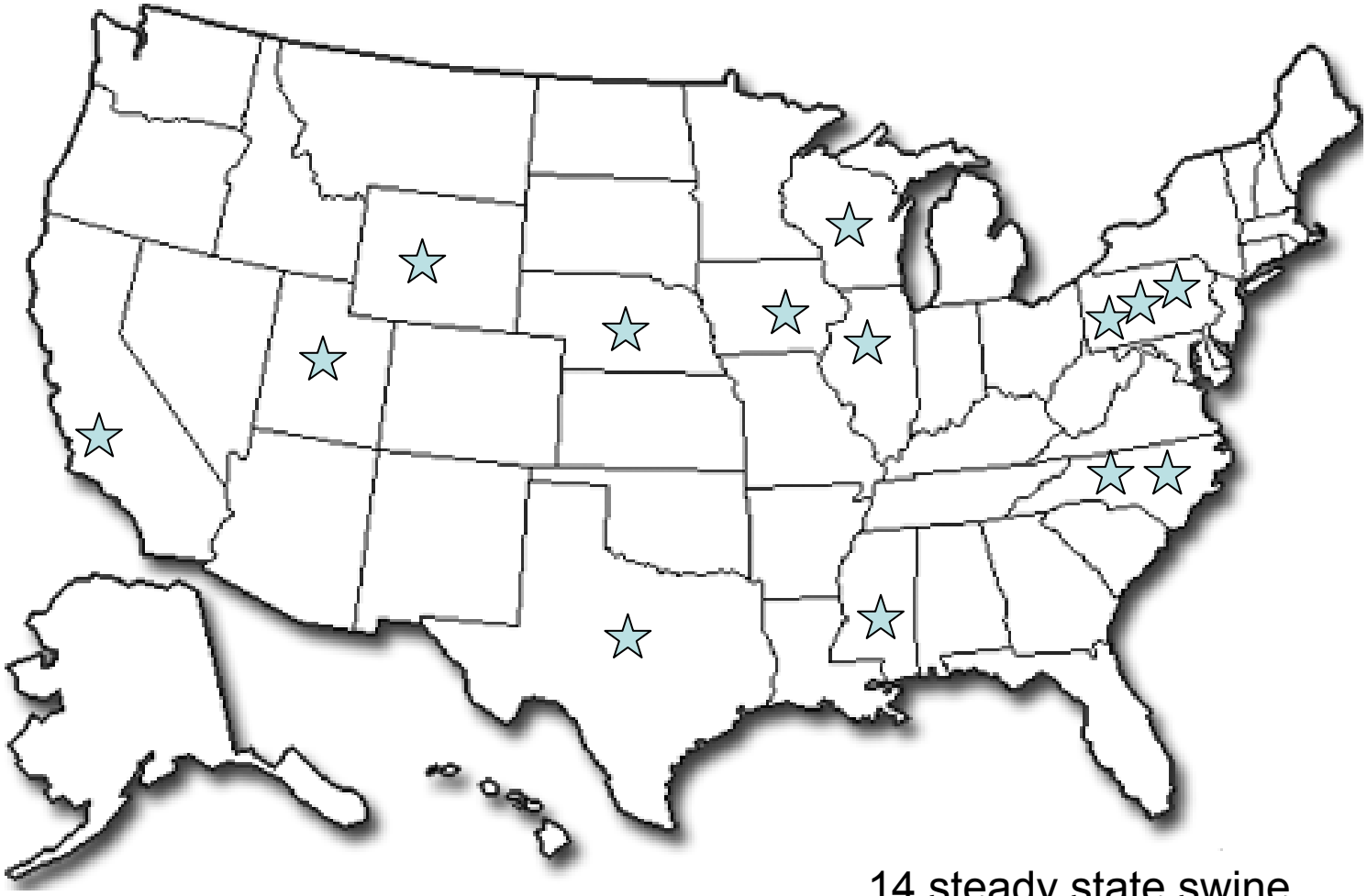
Typical Digester Elements



What can digesters do?

- Offer air quality benefits
  - Reduce greenhouse gases (methane)
  - Control odors from storage and field application
  - Controls other emissions (H_2S, VOCs)
  - Ammonia control will have nutrient implications
- Offer water quality benefits
  - Stabilize manure organics (reduce BOD/COD)
  - Significantly reduce pathogens
- Financial Benefits
  - Only waste management system with potential for return on investment
    - Energy revenues
    - Carbon $
    - Nutrient value
    - Fiber (primarily dairy manure)

Swine Manure Digester Distribution



14 steady state swine manure digesters.

Industry Potential

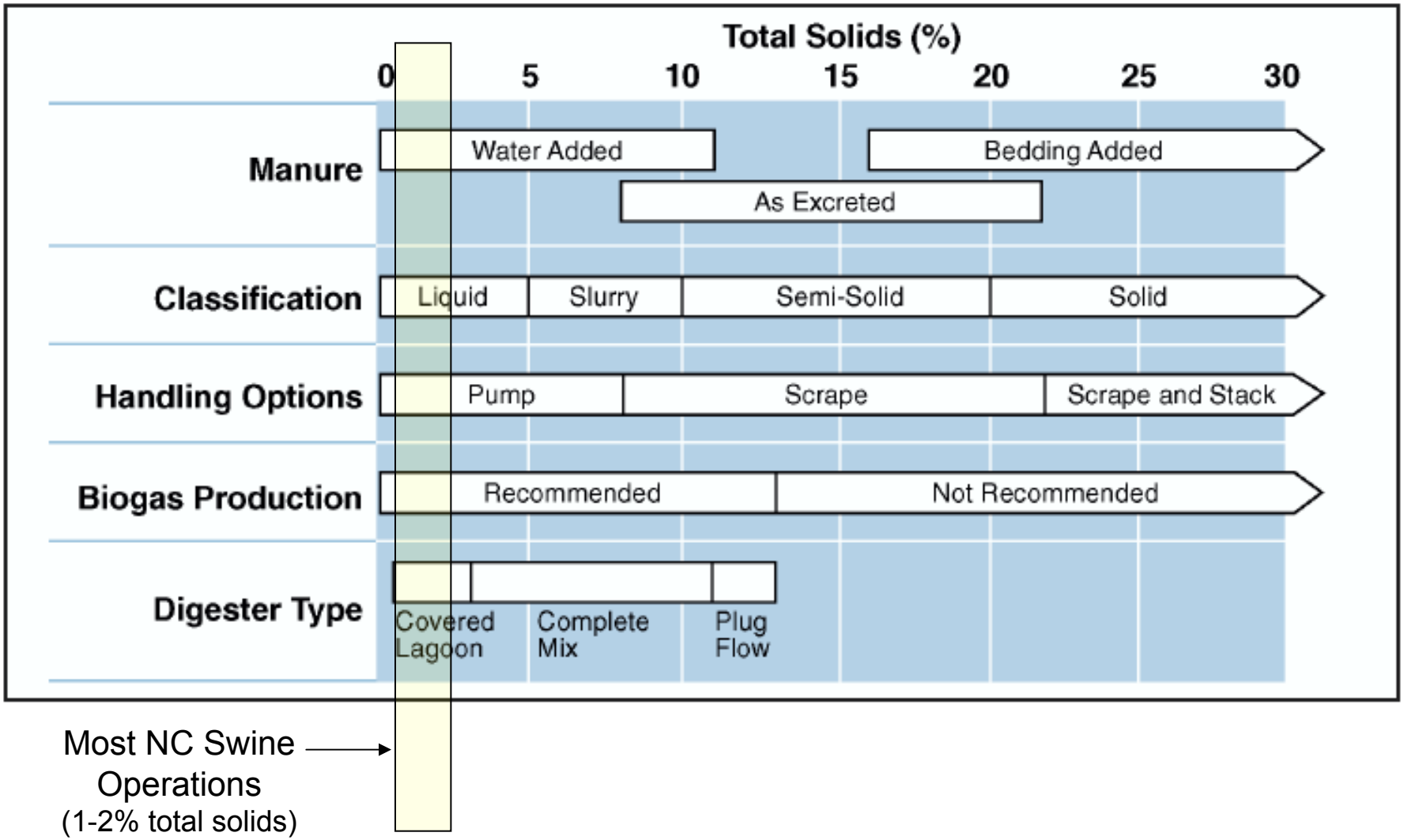
Animal Sector	Candidate Farms	Electricity Generating Potential	
		MW	MWh/year
Swine	4,300	363	3,184,000
Dairy	2,600	359	3,148,000
Total	6,900	722	6,332,000

Animal Sector	2002 Methane Emissions (000 tons/year)	Potential Methane Emission Reduction[1] (000 tons/year)
Swine	1,097	772 (70%)
Dairy	918	573 (62%)
Total	2,015	1,345 (66%)

[1] Estimates are based on installing biogas recovery systems at all feasible operations, as defined in Figure 4.

State	Number of Candidate Farms	Methane Emissions Reduction (000 Tons)	Methane Production Potential (billion ft³/year)	Electricity Generation Potential (000 MWh/year)
SWINE FARMS				
NORTH CAROLINA	1,179	247	11.5	766
IOWA	1,022	126	10.2	677
MINNESOTA	429	40	3.5	234
OKLAHOMA	52	54	2.9	196
ILLINOIS	267	36	2.8	184
MISSOURI	200	53	2.7	177

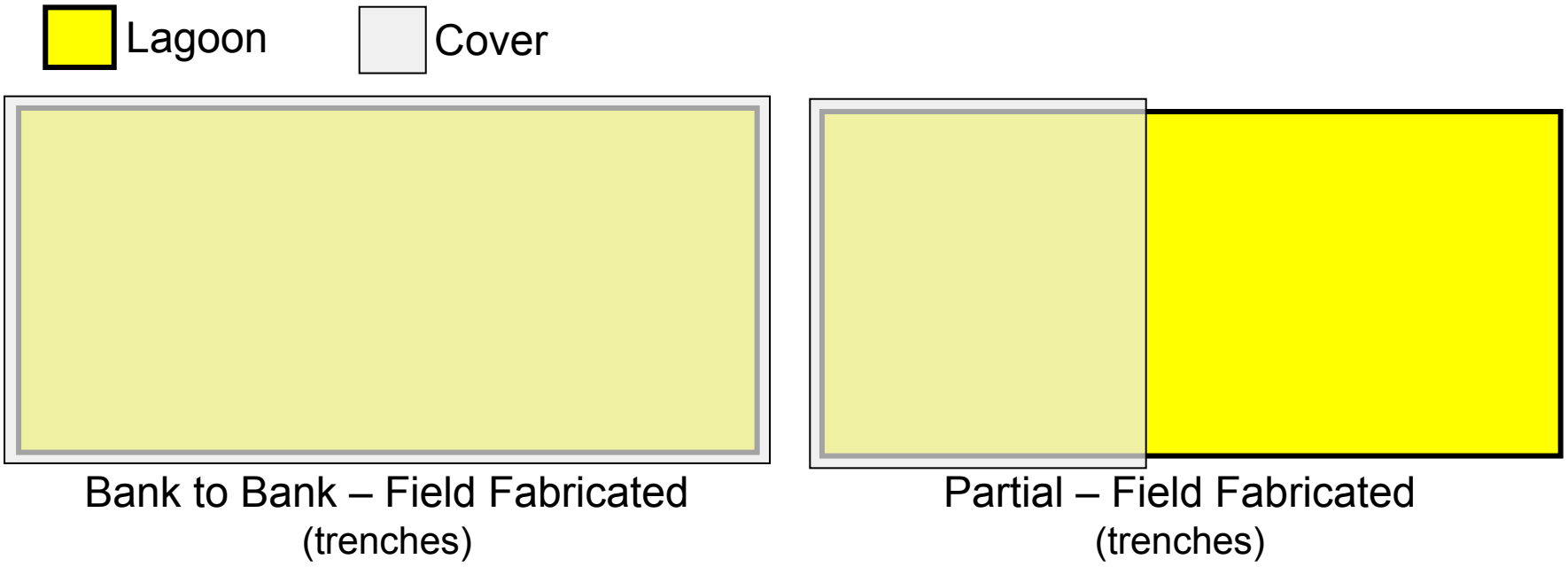
Selecting a Digester Type



Lagoon Digester Types

- Anaerobic Digester Ambient Temperature (*USDA-NRCS Practice Standard 365)*
  - Requires 2 cells
    - First cell: fully covered, continuously fed constant volume treatment lagoon
    - Second cell: effluent storage (pond)
- Emerging
  - Single Cell - Bank to Bank Cover (ECC model)
  - Single Cell - Partial Cover
    - Modular (Mexico)
    - Field fabricated (Murphy-Brown)

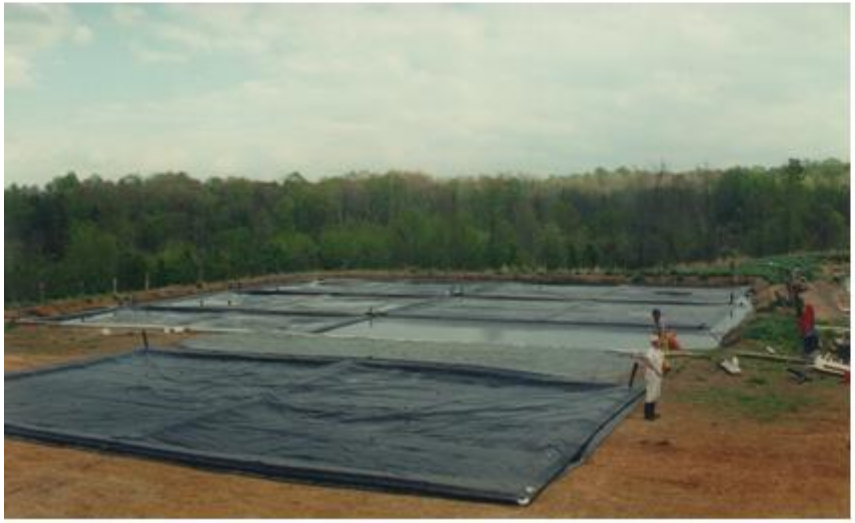
Cover Configurations



Cover Types: Illustrated

Bank-to-Bank

Modular Cover



Material and Design Failures

Cover Design/Installation

- Rule 1 - Work with someone with a proven track record
  - Rule 2: see Rule 1
- Three main considerations:
  - Design: Stress caused by wind, rain and other natural occurring events
  - Materials: Need to resist sun and temperature extremes
  - Fabrication: Cover assembly and installation critical
    - especially for energy projects

Gas Use: Flares

Odor Control and Greenhouse Gas Mitigation (and backup)

Gas Use: Electric

Recip. Engines 40-150kW

Engine Controller

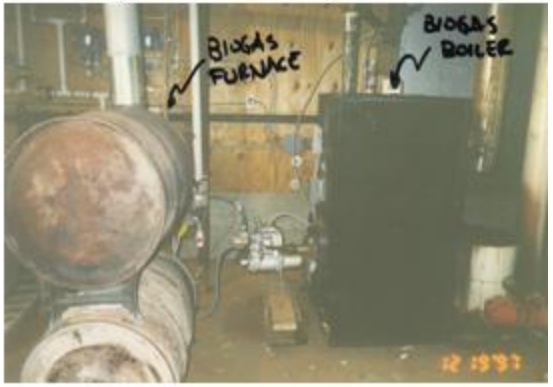
Net Metering

More Engines

Gas Use: Thermal

Boilers

Forced Air



Hot Water Storage

Hot Water Use

Project Types

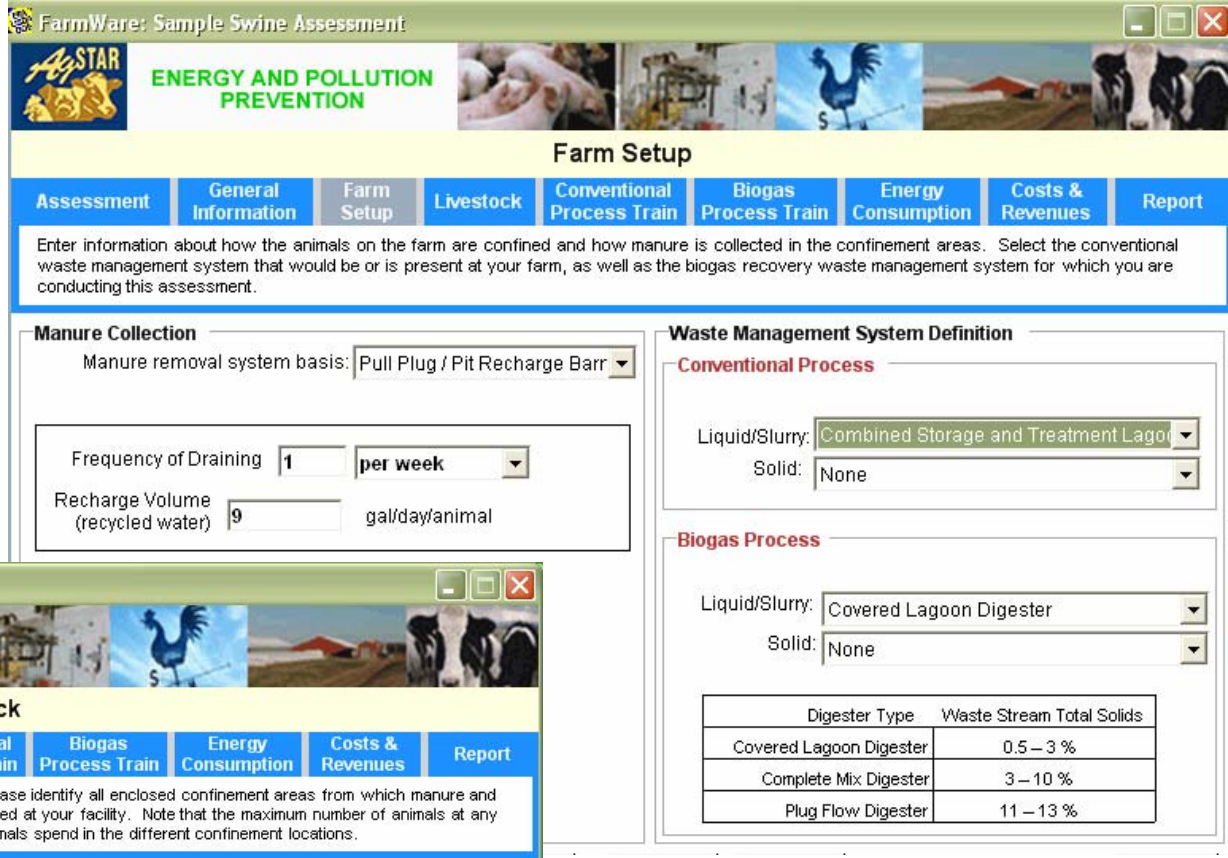
- Single-Farm Digester:
  - Fed by biogas from single producer
  - Ownership and/or operation could be producer
    (Currently the predominant project type in the U.S.)
    - OR third party
- Multi-Farm Digesters (Regional or Centralized):
  - Fed by biogas of multiple producers
    - Moving manure very expensive; moving biogas by pipeline may be better option
  - Could reside at a farm or other location
  - Ownership and/or operation could be producer
    - OR third party
  - Ideally located at or near a large energy user (electricity or biogas) or interconnection point (electric or natural gas grid)

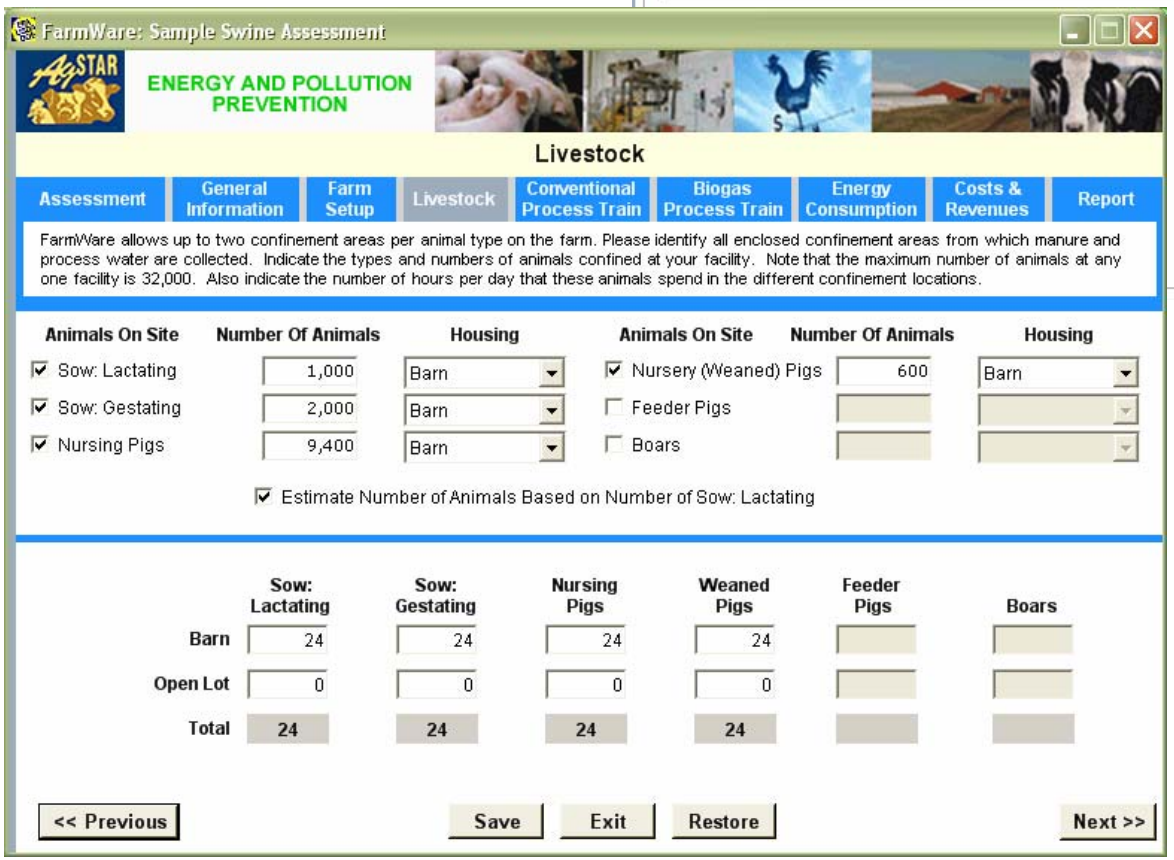
- Either project type could include other organic waste feed stocks.

How can AgSTAR help?

- General Outreach
  - Annual AgSTAR Conference
  - AgSTAR Digest
  - Extension Events/Workshops
- Project Development
  - Industry Directory
  - Funding Guide for Federal and State Resources
- Technical Analysis
  - A Protocol for Quantifying and Reporting the Performance of Anaerobic Digestion Systems for Livestock Manures
  - Project Evaluation Tools
  - AgSTAR Handbook - A Manual for Developing Biogas Systems at Commercial Farms in the United States
  - FarmWare – pre-feasibility
    - For NRCS standard digesters
    - Not for single cell covered lagoons or partial covers

AgSTAR FarmWare





Barham Farms

Zebulon, NC

"I want my operation to produce and exist without my neighbors even knowing I'm there. And I want to leave the environment in better shape than I found it."

Julian Barham, speaking about the environmental benefits of the covered lagoon digester at his 4,000-sow farrow-to-wean operation in North Carolina

AgSTAR Annual Conference 2009

February 24-25, 2009
Hilton Baltimore
Convention Center
Baltimore, Maryland

- Technical Sessions
- Networking
- Tours
- Social Events

For further information…

www.epa.gov/agstar

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